Assignment 7.2 Questions 26, 45, 47, 49, 50, 51, 53, 114, 115

26) Because each element emits a unique spectrum of light. Think of it as an element's fingerprints.

45) a. $E_3 = -2.178 \times 10^{-18}J\ (1^2/3^2) = -2.420 \times 10^{-19}$ J
$E_2 = -2.178 \times 10^{-18}J\ (1^2/2^2) = -5.445 \times 10^{-19}$ J $\quad \Delta E = 3.025 \times 10^{-19}$ J

$\Delta E = h f$ $\quad c = f \lambda$
$3.025 \times 10^{-19} = (6.626 \times 10^{-34})\ f$ $\quad 2.998 \times 10^{8} = 4.565 \times 10^{14}\ \lambda$
$f = 4.565 \times 10^{14}$ Hz $\quad$ ***$\lambda = 6.567 \times 10^{-7}$m or 656.7 nm*** *(red light)*

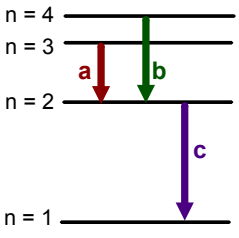
b. $E_4 = -2.178 \times 10^{-18}J\ (1^2/4^2) = -1.361 \times 10^{-19}$ J
$E_2 = -2.178 \times 10^{-18}J\ (1^2/2^2) = -5.445 \times 10^{-19}$ J $\quad \Delta E = 4.084 \times 10^{-19}$ J

$\Delta E = h f$ $\quad c = f \lambda$
$4.084 \times 10^{-19} = (6.626 \times 10^{-34})\ f$ $\quad 2.998 \times 10^{8} = 6.163 \times 10^{14}\ \lambda$
$f = 6.163 \times 10^{14}$ Hz $\quad$ ***$\lambda = 4.864 \times 10^{-7}$m or 486.4 nm*** *(green light)*

c. $E_2 = -2.178 \times 10^{-18}J\ (1^2/2^2) = -5.445 \times 10^{-19}$ J
$E_1 = -2.178 \times 10^{-18}J\ (1^2/1^2) = -2.178 \times 10^{-18}$ J $\quad \Delta E = 1.6335 \times 10^{-18}$ J

$\Delta E = h f$ $\quad c = f \lambda$
$1.6335 \times 10^{-18} = (6.626 \times 10^{-34})\ f$ $\quad 2.998 \times 10^{8} = 2.465 \times 10^{15}\ \lambda$
$f = 2.465 \times 10^{15}$ Hz $\quad$ ***$\lambda = 1.216 \times 10^{-7}$m or 121.6 nm*** *(UV light)*

47)



a = 3.025×10^{-19} J

b = 4.084×10^{-19} J

c = 1.6335×10^{-18} J

50) a. **False**, it takes more energy to remove the electron from the ground state (n=1) than from the 3rd energy level.

b. **True**, the higher the energy state, the farther from the nucleus.

c. **False**, the farther the electron falls, the more energy released. More energy = higher frequency = shorter wavelength.

d. **True**, the energy difference is exactly equal.

e. **False**, n = 2 is the first excited state.

51) $E_1 = -2.178 \times 10^{-18}$ J $\quad E_2 = -5.445 \times 10^{-19}$ J *(both from #45)*

$\Delta E = h f$ $\quad c = f \lambda$
$2.178 \times 10^{-19} = (6.626 \times 10^{-34})\ f$ $\quad 2.998 \times 10^{8} = 3.287 \times 10^{14}\ \lambda$
$f = 3.287 \times 10^{14}$ Hz $\quad$ ***$\lambda = 9.121 \times 10^{-8}$m or 91.21 nm***

$\Delta E = h f$ $\quad c = f \lambda$
$5.445 \times 10^{-19} = (6.626 \times 10^{-34})\ f$ $\quad 2.998 \times 10^{8} = 8.218 \times 10^{14}\ \lambda$
$f = 8.218 \times 10^{14}$ Hz $\quad$ ***$\lambda = 3.648 \times 10^{-7}$m or 364.8 nm***

53) $\Delta E = h f$

$\Delta E = (6.626 \times 10^{-34}) 6.90 \times 10^{14}$ $\Delta E = 4.572 \times 10^{-19}$ J

$E_5 = -2.178 \times 10^{-18}$J $(1^2/5^2) = -8.712 \times 10^{-20}$ J

$\Delta E = E_? - E_5$

4.572×10^{-19} J $= E_? - 8.712 \times 10^{-20}$ J $E_? = 5.443 \times 10^{-19}$ J

5.443×10^{-19} J $= 2.178 \times 10^{-18}$J $(1^2/n^2)$

$0.2499 = 1/n^2$

$4.001 = n^2$ ***n = 2***

Also From #45, we can also see that $E_?$ has the same energy as the 2nd energy level.

114) $\Delta E = h f$ $c = f \lambda$

$3.59 \times 10^{-19} = (6.626 \times 10^{-34}) f$ $2.998 \times 10^8 = 5.418 \times 10^{14} \lambda$

$f = 5.418 \times 10^{14}$ Hz ***$\lambda = 5.533 \times 10^{-7}$m or 5.533×10^{-5} cm***

(Yellow - Green light)

115) $E_4 = -2.178 \times 10^{-18}$J $(1^2/6^2) = -6.050 \times 10^{-20}$ J

$E_2 = -2.178 \times 10^{-18}$J $(1^2/2^2) = -5.445 \times 10^{-19}$ J $\Delta E = 4.840 \times 10^{-19}$ J

$\Delta E = h f$ $c = f \lambda$

$4.840 \times 10^{-19} = (6.626 \times 10^{-34}) f$ $2.998 \times 10^8 = 7.305 \times 10^{14} \lambda$

$f = 7.305 \times 10^{14}$ Hz ***$\lambda = 4.104 \times 10^{-7}$m or 4.104×10^{-5} cm***

(violet light)